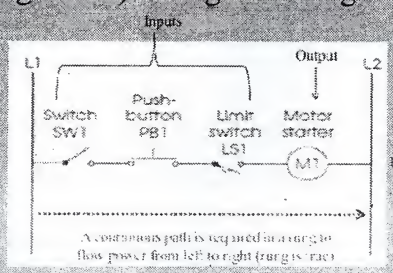
# Sheet (3)

**1- Explain the main difference between ladder diagram and relay logic diagram.**

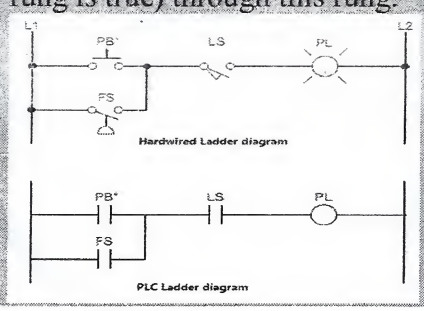
| Relay Logic Ladder Diagram (Hard wired Ladder Diagram) | PLC Ladder Diagram (Ladder diagram) |
|---|---|
| ➢ Like ladder diagram, shows the logical relationship between I/O devices (shows how to control outputs based on input conditions).<br>➢ Certain symbols were used to represent different input and output devices. | ➢ Ladder diagram is a graphical programming method shows how to control outputs and perform functional operations based on input conditions.<br>➢ Normally open (NO) or normally closed (NC) contacts are used for inputs while coils are used for outputs.<br>➢ The contact symbol is the same for any inputs switches (toggle, push button, limit, liquid level, relay contact). |
| ➢ It also called hardwired ladder diagram or relay logic diagram.<br>➢ The PLC power supply will be the voltage between the two vertical lines, labeled L1 and L2. In general, L1 represents the supply terminal and L2 represents the common (neutral) terminal.<br>➢ Relay logic diagrams use rungs (one or more) to accomplish the control of outputs based on input conditions.<br>➢ Power flows through any rung from left to right such that there exist a continuous path (logic continuity = rung is true) through this rung. | ➢ The coil symbol is the same for any outputs (Solenoid, Lamp, Motor, Control relay).<br>➢ The PLC power supply will be the voltage between the two vertical lines (rails or bars), labeled L1and L2. In general, L1 represents the supply terminal and L2 represents the common (neutral) terminal.<br>➢ Relay logic diagrams use rungs (one or more) to accomplish the control of outputs based on input conditions.<br>➢ Power flows through any rung from left to right such that there exist a continuous path (logic continuity = rung is true) through this rung. |

| Inputs | | Outputs | |
|---|---|---|---|
| The input device | Symbol | The output device | Symbol |
| Toggle Switch | | Solenoid | |
| Push button Switch (NO) | | Control Relay (CR) | |
| Push button Switch (NC) | | Motor / Motor starter | |
| Limit Switch (NO) | | Lamp | |
| Limit Switch (NC) | | | |
| Liquid Level Switch (NO) | | | |
| Liquid Level Switch (NC) | | | |
| Relay Contact (NO) | | | |
| Relay Contact (NC) | | | |

| Inputs | | Outputs | |
|---|---|---|---|
| The input device | Symbol | The output device | Symbol |
| Toggle Switch (NO) | | Solenoid | |
| Push button Switch (NO) | | Control Relay (CR) | |
| Limit Switch (NO) | | Motor / Motor starter | |
| Liquid Level Switch (NO) | | Lamp | |
| Relay Contact (NO) | | | |
| Toggle Switch (NC) | | | |
| Push button Switch (NC) | | | |
| Limit Switch (NC) | | | |
| Liquid Level Switch (NC) | | | |
| Relay Contact (NC) | | | |




Simple Relay Logic Ladder diagram



2- **Explain the usage of internal bits used in application memory.**

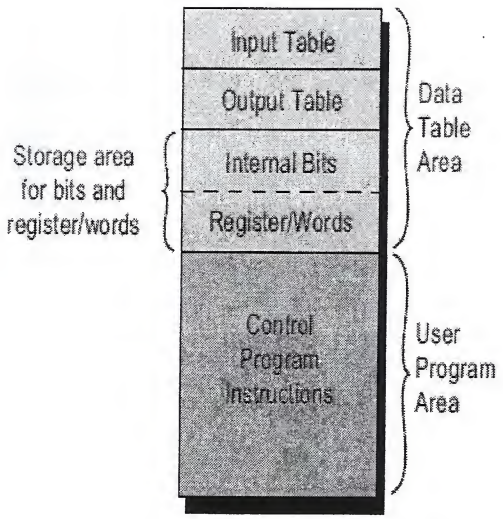
Answer

- Contains storage bits that are referred to as either internal outputs, internal coils, internal (control relays), or internals.
- These internals provide an output, for interlocking purposes, of ladder sequences in the control program.
- Internal outputs do not directly control output devices because they are stored in addresses that do not map the output table and, therefore, any output devices.

3- **What is meant by internal outputs?**

Internal output used exclusively within the program. An internal output does not control a field device. Rather, it provides interlocking functions within the PLC.

4- **The user memory or application memory consists of data table area and user program area. Explain the content and usage of data table area.**

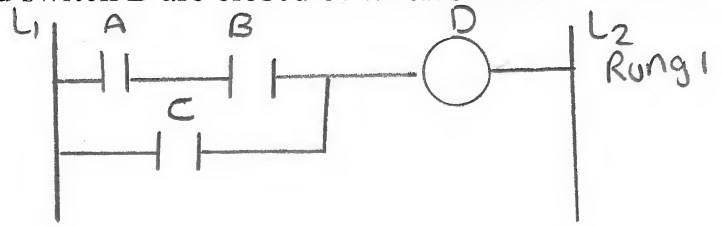



- **Input Table:** stores the status of digital inputs connected to the PLC's input interface.
- **Output Table:** Stores the status of control actions of digital output devices that are connected to the PLC's output interface.
- **Storage Area:**
  - Contains storage bits that are referred to as either internal outputs, internal coils, internal (control relays), or internals.
  - These internals provide an output, for interlocking purposes, of ladder sequences in the control program.

- Internal outputs do not directly control output devices because they are stored in addresses that do not map the output table and, therefore, any output devices.

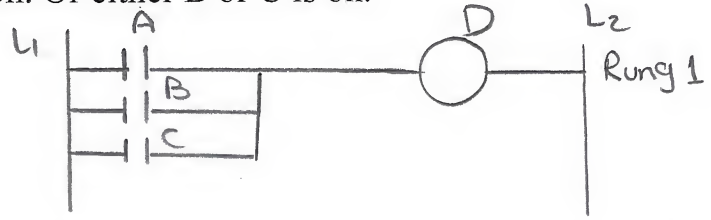
5- Draw a ladder diagram program that will cause output D to go true when switch A and switch B are closed or when switch C is closed.

D = AB+C



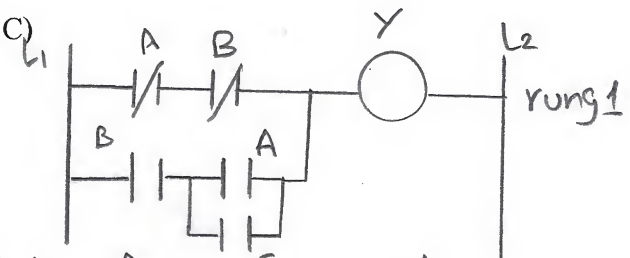

6- Draw a ladder diagram program that will cause output D to be on when push button A is on. Or either B or C is on.

D = A+B+C

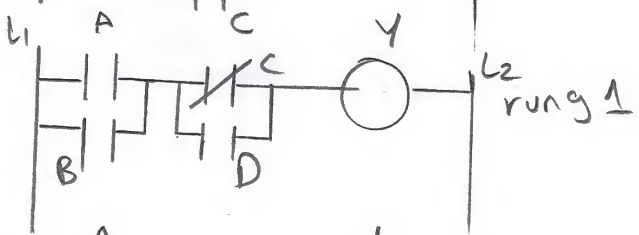



7- Draw the ladder diagram that implement the following logic expressions:

a. Y = A' B' + B (A + C)



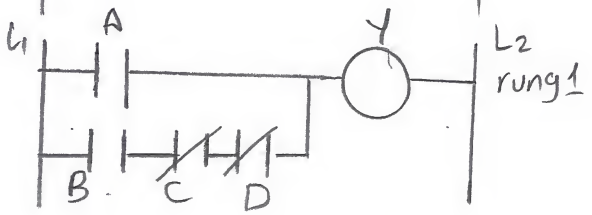

b. Y = (A + B)(C' + D)



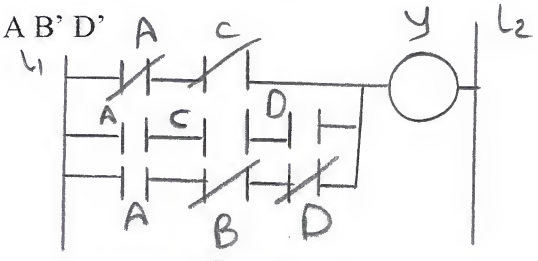

c. Y = A + B (C + D)'

y = A + B(C'D')

y = A + BC'D'

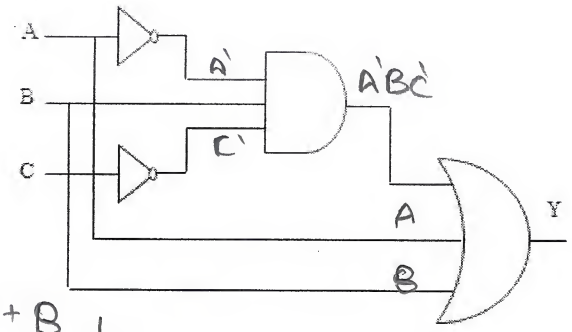



d. Y = A' C' + A C D + A B' D'

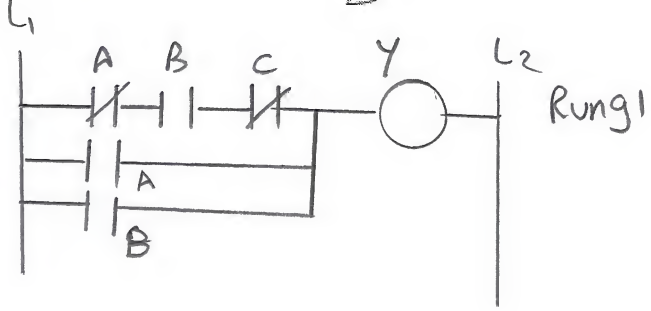


8- Draw the ladder diagram that is equivalent to the following logic circuit:

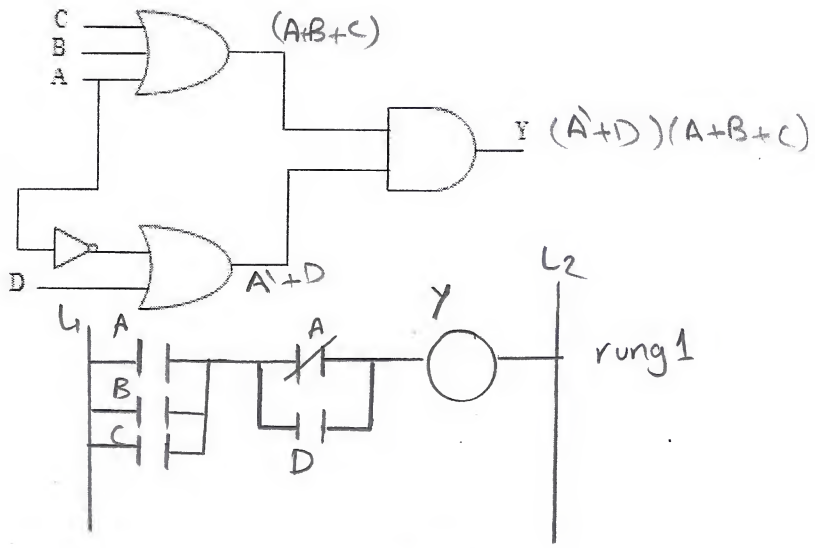
(a)




$Y = A'BC' + A + B$

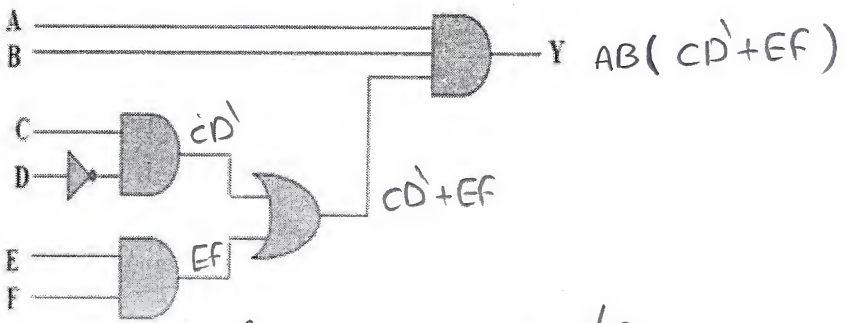



(b)

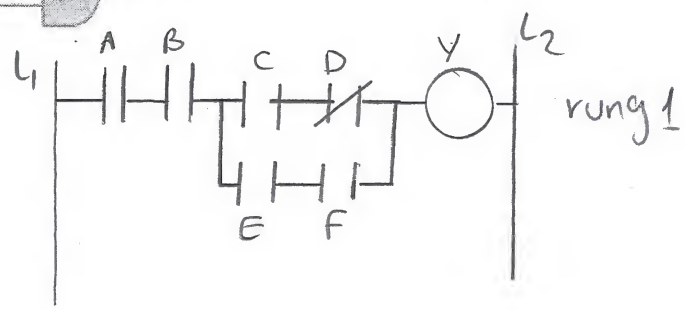



$y = (A+B+c)(A'+D)$

(c)




$y = AB(CD' + EF)$



9- Draw the ladder diagram for a circuit that operates as follows:

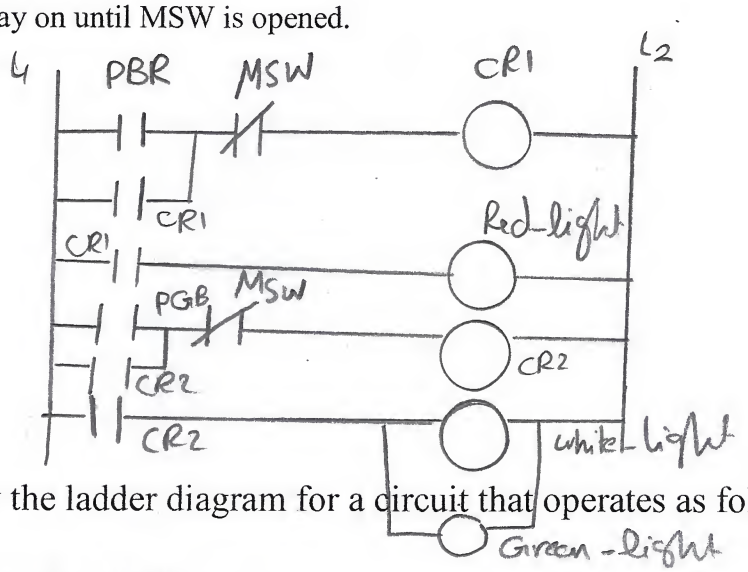
a. The main switch (MSW) is the emergency stop switch, which is normally closed.

b. When the red pushbutton (PBR) is pressed, the red pilot light turns on and stays on and stays on until MSW is opened.

c. When the green pushbutton (PBG) is pressed, white and green pilot lights turn on and stay on until MSW is opened.

MSW NC
PBR NO
↳ red light ON

PGB NO
↳ white light ON
green light ON




10- Draw the ladder diagram for a circuit that operates as follows:

a. The main switch (MSW) is the emergency stop switch, which is normally closed.

b. When the red pushbutton (PBR) is pressed, the red pilot light and motor one (M1) are energized. They will stay on until MSW is opened.

c. Whenthe green pushbutton (PBG) is closed, both white and green pilot lights turn on, and motor one (M1) and motor two (M2) will run. They will stay on until MSW is opened.

MSW NC
PBR NO
↳ red_light ON
(M)Motor1 ON

PGB NO
↳ green/white ON
M1 , M2 ON